MAT-89-03

Issues in Bridge Rehabilitations

Ontario

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Issues in Bridge Rehabilitations

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Abstract:	The report is the copy of a presentation which identifies problems occurring in the preparation and execution of contracts for bridge rehabilitation. Most contracts experience a significant cost overrun and the major contributor is the cost of concrete removal. A number of examples are cited where delays in the program have led to inappropriate engineering solutions or more expensive rehabilitations, and where problems have arisen because of inaccurate detailed condition surveys, lack of information on the condition of the components other than the deck, inaccurate estimates, inexperienced contractors, and inexperienced inspectors. The presentation makes several recommendations with respect to the activities of routine inspections, programming of design and construction, detailed condition surveys, selection of rehabilitation method, contract preparation, construction, and institutional obstacles. The key recommendations concern the stability of the program and funding.
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Issues in Bridge Rehabilitations

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Background

The report is a copy of the presentation "Issues in Bridge Rehabilitation" made to the Provincial Highways Planning Committee on January 31, 1989.

The presentation was initiated by the Structure Durability Committee and prepared by a working group consisting of D.G. Manning, D.F. Barnes, G.C. Burkhardt, and R.S. Reel. A presentation was made to the Structural Management Committee on December 12, 1988. Minor changes were made prior to the presentation to the PHPC.

The recommendations contained in the presentation were approved in principle by the PHPC. A task force under the chair of the Chairman, Structural Management Committee with one representative from each of:

- Transportation Capital Branch
- Structural Office
- Regional Structural Section
- Contract Management Office
- Research and Development Branch

was appointed to develop the details required for implementation of the recommendations. The task force will report to the PHPC periodically.

Issues in Bridge Rehabilitations

Prepared for presentation to the
Provincial Highways Planning Committee
January 31, 1989

The Current System of Structure Rehabilitation

- Routine biennial inspection
- Programming of rehabilitation (5+ years)
- Detailed condition survey
- Select method of rehabilitation
- Prepare contract documents
- Construction

Overruns in Crew Hour and Tender Items in Bridge Rehabilitation Contracts

a) Ottonabee River Bridge/Hwy 7
Site No. 26-061 - Contract No. 86-96

Crew hour overrun	$	134,200	(39%)
Tender overrun	$	653,000	(45%)

b) Hawkesbury Creek/Hwy. 17
Site No. 27-50 - Contract No. 87-50

Extra work to date	$	94,000	(13%)

c) Credit River Bridge/QEW
Site No. 24-203 - Contract No. 87-84

Extra work to date	$	945,000	

d) Russel Road/ Queensway
Site No. 3-265 - Contract No. 87-68

Crew hour overrun	$	34,000	(2790%)

e) Keewatin Channel/Hwy. 17
Site No. 41S-47 - Contract No. 85-454

Crew hour overrun	$	195,000	
Tender overrun	$	1,157,000	(38%)

f) Leslie & Don River/Hwy 401 E B Collector Lanes
Site No. 37-206 & 37-335 - Contract No. 87-93

Extra work	$	1,610,000	
Crew hour overrun, Leslie			(741%)
Don River			(2734%)

g) Sydenham River Bridge/Hwy 80 and 79
Site No. 14-232 and 14-233 - Contract No 88-63

Crew hour overrun	$	87,400	(28%)

Overruns in 1986 Bridge Rehabilitation Contracts

Region	Tender	As Const.	Percent Overrun	Tendered Crew Hour	As Const. Crew Hour	Percent Overrun
Southwest	4,441,349	4,867,350	9.6	112,915	156,916	39.0
Central	16,423,194	18,986,113	15.6	683,478	2,059,352	201.3
Eastern	5,872,195	6,118,025	4.2	275,832	306,249	11.0
North	5,232,556	5,835,409	11.5	65,745	126,712	92.7
Northwest	3,673,831	3,915,587	6.6	202,575	143,990	-28.9
Total	35,643,050	39,722,484	11.4	1,340,545	2,793,218	103.4

Delays Leading to
Inappropriate or More Expensive Rehabilitations.

a) **Hwy. 73/401**
Site 19-304 - Contract 88-61

- Condition Surveys '84
- 1986 schedule delayed to '89
- Updated survey planned for '88 but contract advanced to 1988 without updated survey.
- Overlay, should have replaced deck.

b) **Hwy. 38/Hardwood Creek**
Site 7-38 - Contract 88-17

- Surveys '81 and '85
- Had to replace 3 steel girders due to delays.

c) **Hwy. 38/Sharbott Lake**
Site 7-24 - Contract 88-17

- 1981 Survey - waterproof and pave.
- 1986 Survey - had to replace deck.

d) **Hwy. 38/CPR Overhead**
Site 7-23 - Contract 88-17

- 1981 Survey - waterproof and pave.
- 1986 Survey - overlay.

e) **Jones Creek Bridge/Thousand Island Parkway**
Site 16-110

- 1984 Survey - project deferred.
- 1988 Survey - have to replace deck.

f) **London's Bay, South Structure/Thousand Island Parkway**
Site 16-103

- 1981 Survey - waterproof and pave.
- 1986 Survey - overlay.

g) **Reynold's Road/401**
Site 16-155

- 1981 Survey - waterproof and pave.
- 1986 Survey - overlay.
  - deferred to 1989.

Delays Leading to Inappropriate or More Expensive Rehabilitations

h) Kemptville/Hwy. 43
Site No. 16-18

- 1980 Survey - waterproof and pave.
- 1987 Survey - overlay.

i) CPR Cornwall/Hwy. 401
Site No. 31-214 - twin steel structures.

- 1984 Survey - on coating schedule.
  - still no funds for coating these since they are large structures.
  - other smaller structures in less need have been coated

j) Pitt St., Cornwall/Hwy. 401
Site No. 31-211 - Contract - 87-22

- 1983 Survey - on coating schedule.
  - deck replaced in 1987.
  - still no funds for coating.

k) Steel River Bridge/Hwy 17
Site No. 48E-19 - Contract 87-583

- 1980 Survey - latex overlay, curb and railing repairs.
- 1986 Construction - curbs and railing should have been replaced due to increased deterioration.

l) Nipigon River Bridge/Hwy. 17
Site No. 48C-7 - Contract 87-204

- 1984 Survey - Curb repairs.
- 1987 Contract - Had to replace curbs.

m) Mill Creek/Hwy. 30
Site No. 21-74

- 1985 Survey - Overlay.
- 1988 Survey - Replace bridge.

n) Don River Bridge W.B./Hwy. 401
Site No. 37-335

- 1985 Survey - Overlay.
- 1988 Survey - Replace deck.

Inaccurate Detailed Condition Surveys

a) **Sydenham River/Hwys. 80 and 79**
Site No. 14-232 and 14-233 - Contract 88-63

- Asphalt covered deck.
- Excessive scaling and delaminations not detected.

b) **Don River Bridge, E.B. Collector/Hwy. 401**
Site No. 37-335 - Contract 87-93

- Asphalt covered deck.
- Excessive scaling and delaminations detected but not identified for further investigation.

c) **Keewatin Channel/Hwy. 17**
Site No. 41S-0047 - Contract 85-454

- Asphalt covered deck.
- Survey did not detect all of the scaling and delaminations.

Lack of Detailed Condition Surveys of Components Other Than Decks

a) **Dixon Road/Hwy. 27**
Site No. 37-177 - Contract 87-91

- Detailed condition survey of beams not carried out. Contract terminated after construction began.

b) **Credit River Bridge/QEW**
Site No. 24-203 - Contract 87-84

- Detailed condition survey of arches, soffit and substructure not carried out. Required excessive removal. Soffit shotcrete may not be durable.

c) **South Muskoka River Bridge/Hwy. 11**
Site No. 42-79 - Contract 86-95

- Detailed condition survey of trusses not carried out. Required extra strengthening.

d) **Vermillion River Bridge/Reg. Rd. 55**
Site No. 46-140 - Contract 87-226

- Cracked steel girder found during rehabilitation of deck. Secondary steel members also cracked.

e) **Alta Vista Drive/Hwy. 417**
Site No. 3-69 - Contract 87-35

- Cracked steel girder found after it had been painted over.

f) **Keewatin Channel/Hwy. 17**
Site No. 41S-0047 - Contract 85-454

- No condition survey of beams.
- Extensive replacement of beams.

g) **Nodden Causeway/Hwy. 11**
Site No. 45-75 - Contract 86-225

- 1982 Survey - Contract is still going on.
  - Condition of piers not surveyed.
  - Work on piers required.

Inaccurate Estimates

a) **QEW/15 Mile and 16 Mile Creek**
Site No. 18-22, 18-23

- Design estimate approximately $3.2 million.
- Estimate prior to tender approximately $6.7 million.
- Tenders were above that. Contract cancelled.

b) **Madawaska River Bridge at Griffith/Hwy. 41**
Site No. 29-111 - Contract 86-516

- Barrier wall rehabilitation.
- Design estimate $80,000.
- Tender $190,000.

c) **Still River/Hwy. 69**
Site No. 44-9 - Contract - 86-08

- Pier rehabilitation. Consultant's estimate indicated it would be cheaper to rehabilitate the pier.
- Contractor proposed replacement of the pier and this was accepted.

d) **Burlington Skyway/QEW**
Site No. 36-60

- Inadequate information on cost of coating and environmental protection and condition of piers. Initial cost estimates were low, leading to rehabilitation rather than replacement.

e) **Hawkesbury Creek/Hwy. 17**
Site No. 27-50 - Contract 87-50

- Estimates increased from $300,000 to $1.0 million over a 2 year period during design.

Inexperienced Contractors

a) **North Driftwood River/Hwy. 11**
Site No. 39E-13 - Contract 87-236

- Complex staging, roadway protection, new barrier walls, strengthening, substructure replacement.
- First contractor went bankrupt, only one lane open through winter.
- Second contractor has not finished it either.

b) **Frogs Rapids Bridge/Hwy 72 - Sioux Lookout**
Site No. 41S-5 - Contract 86-504

- Coating contract delayed by two years due to lack of experienced subcontractors.

c) **Grand River Bridge/Hwy. 3**
Site No. 9-43 - Contract 85-524

- Coating contract two years instead of a few months.

Inexperienced Inspectors

Number of contracts in all regions.

Planning, Design and Review Times

a) Condition Survey

- Request Condition Survey
- Write Justification Report
- Prepare Design Criteria and Get Approval
- Scheduling Meeting

b) Selection of Method of Rehabilitation

- Receive Condition Survey Results
- Establish Rehabilitation Methods
- Seek Head Office Approval of Proposals

c) Other Input

- Request Engineering Surveys
- Obtain Traffic Staging Recommendations
- Obtain Geotechnical Recommendations for Approach Roads
- Request Data from Planning and Design
- Contact External Agencies

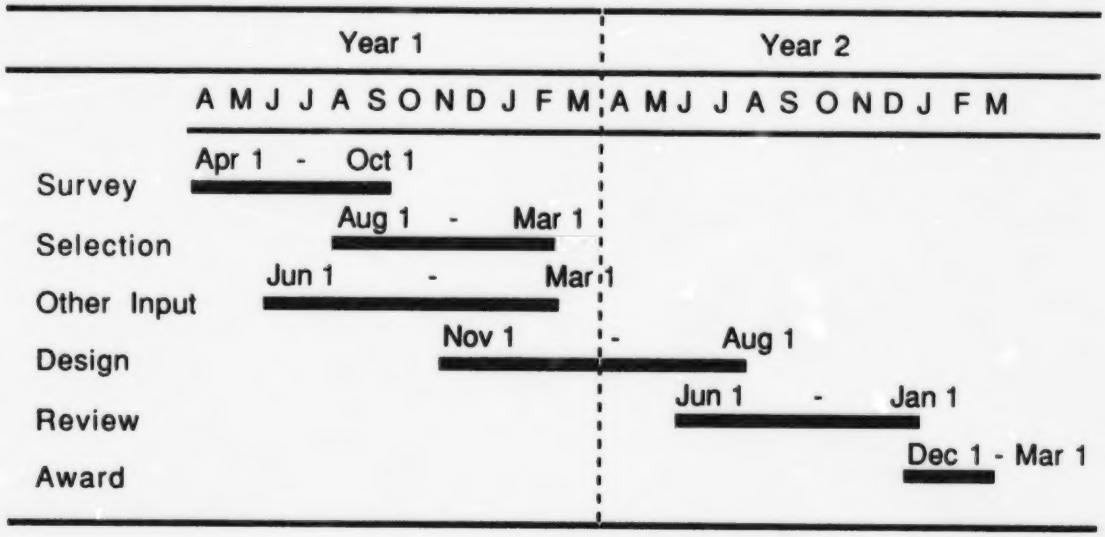
d) Design

- Structural Design Report
- Structural Design and Drawings
- Structural Documents (Specs.)
- Grading Documents and Plans
- Electrical Documents and Plans

e) Review

- Technical Review
- Design Completion
- CMO Review
- CPCS Input and Advertise
- Award

Planning, Design and Review Times


Year 1
Year 2
A M J J A S O N D J F M A M J J A S O N D J F M
Survey
Apr 1 - Oct 1
Selection
Aug 1 - Mar 1
Other Input
Jun 1 - Mar 1
Design
Nov 1 - Aug 1
Review
Jun 1 - Jan 1
Award
Dec 1 - Mar 1

Action Plan - Routine Inspections

Activity	Issues	Action Required	Status
Routine Inspection	Lack of historical data.	Module for recording work done as part of overall BMS.	C
	Shortage of manpower.	Develop criteria for inspection so that effort is proportional to the condition and importance of the structure.	C
	Inflexibility of current approach.	Develop procedures for principal inspections and criteria for use.	B

A — Major new initiative.

B — Minor new initiative.

C — On-going (priorities vary).

Action Plan - Programming

Activity	Issues	Action Required	Status
Programming of Design & Construction	No system for establishing Provincial bridge rehabilitation priorities	Decisions should be based on a Province-wide cost-benefit analysis.	A
	Programming is ill-defined mix of safety, availability of funds, and traffic control.		
	Instability of the rehabilitation program.	Assured funds are required for bridge rehabilitation and associated work.	A
	Planning horizon of 5 years is too long.	A planning horizon of 3 years for bridge rehabilitation combined with assured funding.	A

A — Major new initiative.
B — Minor new initiative.
C — On-going (priorities vary).

Action Plan - Detailed Condition Surveys

Activity	Issues	Action Required	Status
Detailed Condition Survey	Insufficient, reliable information on which to base decisions:	Need to match the extent of the investigation to the condition of the structure:	C
	*technology not sufficiently developed	*determine an appropriate role for DART	A
	*neglected components other than bridge decks	*more training in application of new manual	B
	*lack of flexibility in agreements.	*consultant agreements which recognize the amount of work may vary	A

A — Major new initiative.

B — Minor new initiative.

C — On-going (priorities vary).

Action Plan - Rehabilitation Selection

Activity	Issues	Action Required	Status
Rehabilitation Selection	Most appropriate method of rehabilitation not always selected.	Data on service life.	C
		Cost-benefit analysis must be included in the decision.	C
		Develop decision methodology for components other than decks.	C

A — Major new initiative.
B — Minor new initiative.
C — On-going (priorities vary).

Action Plan - Contract Preparation

Activity	Issues	Action Required	Status
Contract Preparation	Too long a delay between selection of rehabilitation method and award. Inaccurate tender items.	Fast-track rehabilitation contracts (maximum 2 years from survey to construction i.e. survey May-Sept. Year 1, contract award Jan-Feb. Year 2).	A
	Quality of contract documents.	Feedback from construction to design.	C

A — Major new initiative.

B — Minor new initiative.

C — On-going (priorities vary).

Action Plan - Construction

Activity	Issues	Action Required	Status
Construction	Significant delays and overruns.	Examine more innovative solutions to reduce traffic delays.	C
		Implement unit price removals.	C
	Effectiveness of inspectors (number and training).	Examine work duties of inspectors and availability of training aids.	B
	Method of payment for concrete removal unwieldy.	Contractor and MTO must have vested interest in the method of payment.	C

A — Major new initiative.

B — Minor new initiative.

C — On-going (priorities vary).

Action Plan - Institutional Obstacles

Activity	Issues	Action Required	Status
Development and Implementation of Policy	Effect of policy changes on the cash flow and consistency of the program.	Specific dates and criteria for implementation, including identification of discontinued policies.	C
	Effect of training programs. Shortage of staff - quality and number.	Identification of training needs. Ensure core staffing levels are adequately maintained together with appropriate training.	C

A — Major new initiative.
B — Minor new initiative.
C — On-going (priorities vary).

Recommendations for Consideration by PHPC (Status A Actions)

1. **For approval in principle.**

   a) Ensure adequate funds for bridge rehabilitations and associated works.

   b) Base structure rehabilitation programs on Province wide cost-benefit analysis.

   c) Use a three year planning horizon for bridge rehabilitation projects.

   d) Fast track rehabilitation contracts with a maximum time of two years from condition survey to construction;
   - year 1, survey May-September
   - year 2, contract award January-February

   e) Prepare more flexible consultant assignments which match the extent of the investigation to the condition of the structure.

   f) Ensure core staffing levels are adequately maintained together with appropriate training.

   g) Determine an appropriate role for DART.

2. **Proposed method of implementation.**

   Establish a task force reporting to PHPC with the following members:
   - Chairman, Structural Management - Committee - chairman

   - One representative from each of:
     Transportation Capital Branch
     Structural Office
     Regional Structural Section
     Contract Management Office
     Research and Development Branch

Other Recommendations (Status B and C Actions)

a) Provide more training in the application of the new procedures contained in the Structure Rehabilitation Manual and the Structure Financial Analysis Manual.

b) Examine work duties of inspectors and availability of training aids.

c) Develop procedures for principal inspections and their use.

d) Develop criteria for inspections so that the effort is proportional to the condition and importance of the structure.

e) Develop new modules in the Ontario Structure Inventory System, OSIS, to record the rehabilitations carried out, and the service lives of rehabilitations as part of an overall bridge management system.

f) Develop criteria and decision methodology for components other than decks.

g) Improve feedback from construction to design.

h) Implement unit price removals for concrete quantities, and ensure that the contractors and MTO have vested interest in the method of payment.

i) Examine more innovative solutions to reduce traffic delays.

j) Assign specific dates and criteria for implementation of new policies, including identification of discontinued policies.

k) Identify training needs at all levels.

Benefits

a) Substantial increase in benefit-cost ratio for investments in existing structures.

b) Better cash-flow management.

c) Improved bridge management practices;

- more timely interventions
- appropriate solutions
- better utilization of human resources
- higher quality construction

d) Improved level of service to the public.